REMARKS

The response is being filed coincident with a Request for Continued Examination. It is responsive to the Office Action dated December 30, 2009, the Advisory Action dated February 2, 2010, and the interview between the Examiner and the Applicants' representative, Thomas Dekleva, which took place on or about February 21, 2010, during which the Examiner clarified the remarks of the Advisory Action. Dr. Dekleva wishes to thank the Examiner for the courtesy extended to him during that interview.

Claims 1, 2, 4-6 and 8-16 are pending in the application. Claims 1, 2, 4-6 and 8-16 are rejected. Claims 1, 6, 8, 9, 10, 14, and 15 are currently amended. Claim 16 is canceled. Claims 17-20 are added. No new matter is entered upon entry of these claims or amendments.

Claim 1 is reconfigured as a method of producing a nanoporous carbide-derived carbon composition having mean nanopore diameter within the range of 0.05 nm to about 0.2 nm of a selected value. The claim describes a method implicit in the concept of tunability, said concept finding support throughout the specification

Claims 1, 10, and 15 are amended to clarify that the carbides are metal or metalloid carbides, such as exemplified by the listing of metals and metalloids in Claim 10.

Claims 1 and 15 are amended to reflect that the first, second, and third temperatures are different. Support for these amendments are found in Figures 1a, 2b, and 2c.

Claims 6, 8, and 9 are amended to clarify the language of the claims.

Claim 14 is amended to correct a typographical error.

Claims 17 and 18 are added to describe the carbides in terms of binary and ternary carbides and to claim ternary mixtures of Si, Ti, and C. Support for this claim is found, *inter alia*, on page 4, lines 26-33 and in claims 2 and 10.

Claim 19 is added to specify a minimum difference between the two temperatures of claim 1. The difference described represents that value within which commercial kilns can accurately control.

Claim 20 describes one difference between the two temperatures of claim 1. Support for this claim in Figure 2.

I. Claim Rejections under 35 U.S.C. §112, second paragraph

Claims 8 stands rejected under 35 U.S.C. §112, second paragraph, as being allegedly indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention. More particularly, the Examiner states that "Claim 8 contradicts claim 1, and reads upon the normal desired result of repeating an experiment to ge [*sic*] the same result, since claim 1 does not require that the two temperatures be different" (Office Action dated 12/30/09, page 2, paragraph 3).

Claims 1 and 15 have been amended, *inter alia*, to specify that the second or successive temperatures are different from one another or from preceding temperatures. Claims 18 and 19 further quantify these differences. Applicants consider this action responsive to the Examiner's rejection and ask that it be withdrawn.

II. Claim Rejections under 35 U.S.C. § 102(b) or 35 U.S.C. §103(a) – "*Leis*."

> Claims 1, 4-6, 8, 9, 11-16 stand rejected under 35 U.S.C. §102(b), as being allegedly anticipated by, or in the alternative, under 35 U.S.C. 103(a) as obvious over Leis J., *et al.*, "Carbon nanostructures produced by chlorinating aluminum carbide," *Carbon*, 2001, 39, 2043-2048 (hereinafter "*Leis*").

Applicants believe that the current amendments moot the novelty and obviousness rejections.

The Applicants disagree with the characterization that this reference anticipates or renders obvious the claims of the instant invention which describe a method of selecting a specific pore size within the constraints of the claims.

To show anticipation, the Office must prove, clearly and unequivocally, that each limitation of the pending claims is described in a single prior art reference. Atofina v. Great Lakes Chem. Corp., 441 F.3d 991, 999 (Fed. Cir. 2006). "A claim is anticipated only if each and every element as set forth in the claim is found, either expressly or inherently described, in a single prior art reference." MPEP 2131. Moreover, "[t]he invention must be shown in as complete detail as is contained in the . . . claim." *Id.* In addition, "[t]he elements must be

arranged as required by the claim." *Id.* *Leis* fails to teach every element of the claim, arranged as required by the claims, in the complete detail required under 35 U.S.C. § 102.

Independent claim 1 of the present application (and accordingly all claims which depend on claim 1) contains the limitation that halogenating two samples of the same carbide material at two temperatures produces two nanoporous carbon samples whose mean nanopore diameter differs by an amount in the range of from about 0.05 nm to about 0.2 nm. Nowhere in *Leis* is this feature described, either explicitly or implicitly, and the Office Action has failed to show where such teaching is made. At best, *Leis* discloses that halogenating a given set of carbide samples at different temperatures results in carbon samples whose nanopore sizes differ by the approximate thickness of a graphitic layer; i.e., ca. 0.3 nm (e.g., Table 1). Since *Leis* does not disclose this limitation of claim 1, it cannot be said to anticipate.

Similarly, the standard for establishing a *prima facie* case of obviousness requires that three basic criteria *must* be met. First, there must be some suggestion or motivation, either in the reference itself or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or to combine reference teachings. Second, there must be a reasonable expectation of success. Finally, the prior art reference must teach or suggest all the claim limitations. The teaching or suggestion to make the claimed combination and the reasonable expectation of success must both be found in the prior art, and not based on Applicants' disclosure. MPEP § 2143, In re Vaeck, 947 F.2d 488, 20 USPQ2d 1438. Applicants submit that the Office Action does not set forth any of these requirements. Not only does the single *Leis* reference fail to teach or suggest all the claim limitations of the rejected claims, but the Examiner has failed to provide any suggestion or motivation, either in the reference itself or in the knowledge generally available to one of ordinary skill in the art, as to why the invention disclosed in *Leis* would be modified to produce the instant invention or that the skilled artisan would have any reason to expect success.

As to claim 16, the reasons given by the Examiner do not support a finding of either anticipation or obviousness.

For the foregoing reasons, Applicants respectfully request the Examiner to withdraw this rejection.

III. Claim Rejections under 35 U.S.C. § 103(a) – *"Leis"* taken with *"El-Raghy."*

Claims 1, 2, 4-6, 8-16 stand rejected under 35 U.S.C. §103(a), as being allegedly unpatentable over Leis J., *et al.*, *Carbon*, 2001, 39, 2043-2048 (hereinafter "*Leis*"), taken with El-Raghy, *et al.*, *J. Appl. Phys.*, 1998, 83(1): 112-119 (hereinafter "*El-Raghy*").

Applicants traverse this rejection. Referring again to the three-part standard for establishing a *prima facie* case of obviousness described above, even if the Applicants were to concede that the skilled artisan might be motivated to halogenate *El-Raghy's* composite of TiC and SiC (a point that the Applicants do not necessarily concede), the Examiner has not explained or demonstrated why the skilled artisan would reasonably expect success in replicating the claims at issue (i.e., changes in pore sizes of from about 0.05 nm to about 0.2 nm), nor do either of these references contain all of the claim limitations described in the rejected claims. As such, the Examiner has failed to make out a *prima facie* case for obviousness, and the Applicants respectfully request reconsideration and withdrawal of the rejection

IV. Claim Rejections under 35 U.S.C. § 102(b) or 35 U.S.C. §103(a) – *"Boehm"*.

Claims 1, 4-6, 8-16 stand rejected under 35 U.S.C. §102(b), as being allegedly anticipated by or in the alternative, under 35 U.S.C. 103(a), as allegedly obvious over Boehm, *et al.*, Proc. 12th Biennial Conf. on Carbon, 1975, pp. 149-150 (hereinafter "*Boehm*"). Specifically, the Examiner remarks that "[p]age 149 teaches narrow-pore distribution carbon made from reacting TaC with [*sic*] at 500C. The results of several different temperatures are plotted and correlated." (Office Action dated 12/30/09, page 2, last paragraph).

Once again referring to the requirements for a finding of anticipation, Applicants assert that the Examiner has failed to show that "each and every element as set forth in the claim is found, either expressly or inherently described, in [this] single prior art reference" and / or that the invention is "shown in as complete detail as is contained in the . . . claim." Specifically, there is no teaching on page 149 of this reference that "nano-pore distribution carbon [can be]

made from reacting TaC with [sic] at 500C." The discussion on page 149 is limited to that of changes in crystallographic cell parameters, a feature not contained or correlated with nanopore size of the rejected claims. Even to the extent the page 150 (Figure 2) describes pore *volume*, it does not described nanopore *diameter*, as described in these claims. As such, *Boehm* does not show that "each and every element as set forth in the claim," and so does not anticipate the rejected claims.

Once again, referring to the three-part standard for establishing a *prima facie* case of obviousness described above, the fact that this single reference fails to teach or suggest all the claim limitations of the rejected claims is fatal to a finding of obviousness.

Accordingly, Applicants request reconsideration and withdrawal of the rejection.

V. Claim Rejections under 35 U.S.C. § 102(b) or 35 U.S.C. §103(a) – *"Mohun"*.

Claims 1, 4, 6, 8-14, and 16 stand rejected under 35 U.S.C. §102(b), as being allegedly anticipated by or in the alternative, under 35 U.S.C. 103(a), as allegedly obvious over Mohun, U.S. Patent 3,066,099 (hereinafter "*Mohun*").

Specifically, the Examiner remarks that "[t]he reference teaches, especially in col. 6, 10, 35, and 36 heating SiC with chlorine at various temperatures to make a microporous material. No difference is seen in the pore distribution.. . . *Mohun* col. 6 indicates some predictability is well known." (Office Action dated 12/30/09, page 3, 2nd paragraph).

Again referring to the requirements for a finding of anticipation or obviousness, Applicants assert that the Examiner has failed to show that "each and every element as set forth in the claim is found, either expressly or inherently described, in [this] prior art reference" and / or that the invention is "shown in as complete detail as is contained in the . . . claim."

Mohun's column 6 generally describes attributes of activated carbon made from organic polymer precursors but does not discuss reaction of SiC (or any carbide) with chlorine. In fact, this section appears to describe changes which occur in prior art chemistries (i.e., carbons formed by incomplete combustion and not halogenation of carbides). Any "predictability" expressed by

Mohun, to the extent that it exists, does not appear to refer to carbons prepared by the methods of the present invention.

Mohun's column 10 describes the reaction of SiC with chlorine to form activated carbon and $SiCl_4$, but provides no discussion as to the nature of the pore sizes or the ability to vary pore sizes with temperature (or any other parameter).

Mohun's columns 35 and 36 describe the results of chlorinating SiC at two temperatures and the resulting ash contents, electrical resistivities, vapor capacities, heats of wetting, and chlorine gas adsorption capacities, but do not describe or imply the limitations provided for the rejected claims.

Applicants are unable to identify any teaching within *Mohun* which would suggest the limitations of any of the claims currently rejected on the basis of this reference. In the absence of such teaching, Applicants request reconsideration and withdrawal of the rejection.

VII. Concluding Remarks

Finally, the Office Action incorrectly concludes with the statement that:

> *Applicant's arguments filed 9/9/09 have been fully considered but they are not persuasive. The arguments essentially are that the claimed process surprisingly gives a predictable result. However, the claims only require that different temperatures give different results and the references remaining demonstrate this, even though the various authors do not express and significance of these findings.* (Office Action dated 12/30/09, page 3, 2nd paragraph).

The Applicants completely disagree with this conclusory characterization. First, as described extensively in their last response, Applicants are unaware of any predictability in the finding that carbides can be halogenated under conditions resulting in variations in pore sizes in the range of from about 0.05 nm to about 0.2 nm; nor has the Examiner since provided any evidence of such predictability of result. The Applicants have described and supported their understanding of the prior art thinking that variations in nanopore sizes were subject to discrete "jumps" (or quanta), the distances of those "jumps" associated with the distance between graphitic layers; i.e., ca. 0.3-0.4 nm, such that the available pore sizes for a given carbide

composition was limited to a finite number of pore sizes by the nature of the original carbide composition. Their discovery of the "tunability" of such nanopore sizes was made in the face of this contrary thinking.

As stated previously, the Applicants assert that they have discovered that, through careful selection and *control of processing temperatures, for a given carbide* precursor, it is possible to control and define the nanopore sizes and nanopore size distributions of the resulting carbon articles, and that, within a given carbide composition, these nanopore sizes are not subject to quantized 'jumps.'

In but one example described previously, Fedorov (Mendeleev Chemistry Journal, 39 (6) pp. 87-87) describes the "chlorination of metal carbides at high temperatures is among the number of quite well-studied and assimilated processes in non-ferrous metallurgy and the chemical industry," (page 88, line 3-4). Reporting on the range of work conducted at the Leningrad Institute of Technology during the period 1977-1992, which focused on the "[c]onditions of carbide chlorination . . . including a thermodynamic analysis of reactions and the experimental study of their kinetics as a function of such factors as temperature, reaction ratio, dispersion of carbides, and conditions of contact of carbide with chlorine," describes *only* the impact of reaction ratio, dispersion of carbides, and conditions of contact of carbides with chlorine as they relate to final pore sizes.

Similarly, Gordeev, *et al.* (WO 98/54111, page 7, line 26 through page 8, line 20) describes *inter alia* the prevailing thinking until the present Applicants' invention:

> *Current notions of carbon material structure point out that nanopores generated during the thermochemical treatment process are* ***formed by ordered or disordered graphite planes of carbon****, which for simplicity might be considered as shaped slots,* ***the width of the latter depending on the type of carbide*** *used for forming of the workpiece with transport porosity.*

The same reference goes on to describe a formula for determining **nanopore sizes which depend *exclusively* on the nature of the carbide precursor**.

The Applicants discovered that it is possible to provide compositions from a given carbide precursor with much smaller differences, so as to "de-limit" the number of mean pore sizes available from a given carbide composition. In this way, it is possible to "tune" the final

compositions, and such is implicit in the use of this term "tuneable." The Applicants are unable to find any evidence that such nanopore "de-limited tuning" has been previously described by varying halogenation temperature, either explicitly cited or necessarily inherent in, or taught by any of the art cited by the Office. Nor has the Office provided any additional evidence of such prior art teaching.

Contrary to the Office's position that "the various authors do not express any significance in these findings," Leis *et al.*, one of the parties cited by the Examiner in this action, co-applied for a patent in this area (WO 2005/118471), acknowledging only after the present invention that "the peak pore size [can] be adjusted within a few angstroms by changing the carbide chlorination temperature," citing the present Applicants' work (page 1, lines 23-25). Additionally, as previously reported by the Applicants, R&D Magazine has recently described this finding as one of the revolutionary technologies of 2009.

Finally, in keeping with Applicants' duty of candor and full disclosure, Applicants wish to direct the Examiner's attention to a recent action in the prosecution of U.S. Application Serial No. 12/094,501. This notice is made solely for completeness and should not be taken to suggest that the Applicants agree with the bases for these rejections. Applicants assume the Examiner has ready access to this action and case. However, should this not be the case, Applicants will provide this.

In view of the foregoing reasons, Applicants submit that the pending rejections should be reconsidered and withdrawn. Accordingly, Applicants submit that all pending claims are in condition for allowance and earnestly solicit the Examiner to allow the application on the existing claims. Should the Examiner find that the claims are not in condition for allowance, Applicants request that he call the undersigned attorney at the number listed below to advance the prosecution of this application.

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